



US Army Corps
of Engineers
Waterways Experiment
Station

Zebra Mussel Research

Technical Notes

Section 1 — Environmental Testing

Technical Note ZMR-1-18

May 1994

Zebra Mussel Infestation at Black Rock Lock, Buffalo, New York

- Background and purpose** Zebra mussels were first found at Black Rock Lock, located at the end of a 4.1-mile channel bypassing a section of the Niagara River, in the late 1980s. The purpose of this technical note is to describe the infestation at the lock and some of the measures taken to remove zebra mussels during a pumpout in January 1993.
- Additional information** This technical note was written by Mr. Gary Dye, Lock Master, U.S. Army Engineer District, Buffalo, Buffalo, NY. For more information, contact Mr. Dye at (716) 879-4427. Dr. Ed Theriot, U.S. Army Engineer Waterways Experiment Station, (601) 634-2678, is Manager of the Zebra Mussel Research Program.
- Note:** Non-SI units of measurement used in this technical note can be converted to SI units as follows. Multiply feet by 0.3048 to obtain meters, multiply inches by 2.54 to obtain centimeters, and multiply miles (U.S. statute) by 1.609347 to obtain kilometers.
- Description of the lock** The chamber of Black Rock Lock is 650 by 70 ft, enlarged by approximately 100 ft (total length) during pumpout with guard gates closed. The upper end of the lock is at Lake Erie level with no water control structure. The channel at the lower end of the lock re-enters the Niagara River. There is not a constant flow of water either through or around the lock from the channel.
- The average lift of the lock is 5.5 ft, with a draft of 21.5 ft over the sills at low water depth. All of the gates have wood miters and quoins. The lock is serviced by a 6-ft culvert in both walls. Lateral culverts (18 by 18 in.) run from the culverts into the chamber. There are two gate valves in each operating gate, approximately 39 by 84 in. Actual lift time of the lock is 12 to 15 min. Black Rock Lock has no gauge wells or transducers.
- Infestation by zebra mussels** As of early 1992, virtually every surface, regardless of the type of material, was completely covered with zebra mussels. The infestation was 1.5 to 4 in. thick at the upper end of the lock, although the greatest portion of the coverage measured between 1.5 and 2 in. The lower end of the lock was covered with a single layer of mussels. The materials infested with zebra mussels are concrete, steel, granite, oak, and polyvinyl chloride (PVC) pipe and cable coatings. Zebra mussels appeared to exhibit no preference for a particular substrate type. In areas of

intermittent flow, such as the culverts and around valves, the only area free of mussels is the direct blast zone. When valves are opened, the resulting water force exceeds byssal thread attachment strength. The quoins and miters were kept clean by repetitive contact with no signs of abrasion.

Debris After pumping the lock down in early 1993, maintenance personnel noticed attached and unattached living mussels and shell debris around the sills. In the past, these areas were relatively clean; usually sediment and other debris was carried away by water currents. The areas not cleaned by the sweep of the gates had a 3- to 4-in. coating of live and dead mussels. Behind the gates, debris was 10 to 12 in. deep.

Freeze kill Pumpouts at the Black Rock Lock take place in the winter when there is ice in the channel and on Lake Erie (Figure 1). This provides for a natural freeze kill, although varying temperature conditions throughout the lock affect the amount of time required to completely kill exposed mussels. In 1993 the lock had been pumped out for 8 weeks and some areas still contained live mussels. The most rapid kills were in areas exposed to direct air temperature and sunlight, no moisture, with only a single layer of mussels. In these areas, dead mussels were observed in 3 days; within 5 days, shells were completely open and most of the tissue had deteriorated. Layers of mussels 2 in. deep or thicker required 3 to 4 weeks for a complete kill. In protected areas with high moisture, some mussels were not killed during the pumpout period. Mussels stayed alive for 6 weeks in the culvert, which was moist and protected from extreme low temperature. A layer of snow or ice appeared to protect thick layers of zebra mussels.

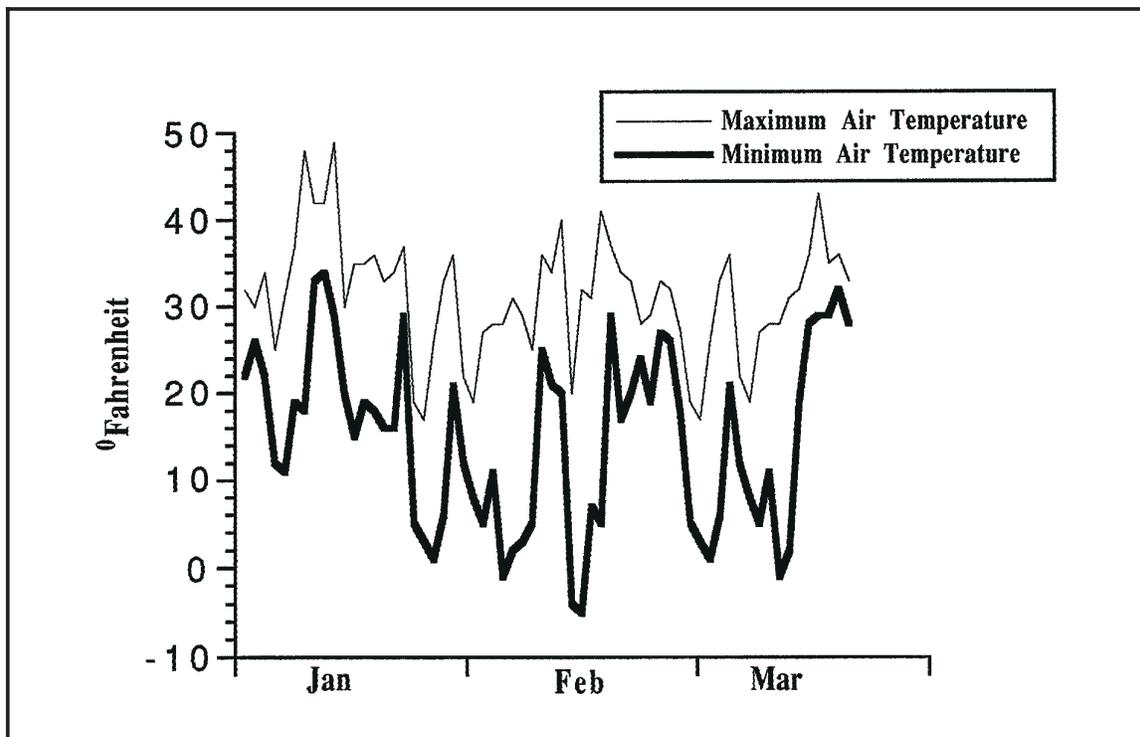


Figure 1. Maximum and minimum air temperatures, January-March 1992, at Black Rock Lock, New York. [To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9) (F - 32)$]

Removal and cleaning Only areas where repairs were necessary or a visual inspection had to be made were cleaned of zebra mussels. Any area of freeze kill that was completely dry was easy to clean. Dry shells remaining on the surfaces were removed with brooms, scrapers, or by hand with very little effort. Thick mats with a soft layer of byssal threads retained moisture and accumulated debris but were still fairly easy to remove manually. A hammer and chisel were used to remove mixtures of ice and frozen mussels. Scale and byssal threads remaining on the surface had to be removed with a wire brush. Zebra mussels had to be shoveled off sills to eliminate shoaling caused by the sweep of the gates.

Manual removal of zebra mussels did not interfere with scheduled maintenance although it did add to the time required to complete various tasks. Odor from dead mussels was not a severe problem at Black Rock Lock, probably because the pumpout took place during the winter when decomposition rates were relatively low. Large numbers of dead zebra mussels can cause considerable odor (see Zebra Mussel Technical Note ZMR-4-04, Shafer 1993).

Physical damage No apparent damage was observed to any of the surfaces infested with zebra mussels. There is a potential for damaging surfaces by cleaning methods which often require enough force to damage coatings and concrete. A greater degree of corrosion to steel surfaces was noted under thicker masses of zebra mussels. However, the cause has not been fully determined and is still under study.

Summary The maintenance work at the lock was not greatly affected by the presence of zebra mussels. However, some issues pertaining to the infestation were not completely addressed. For example, there was no attempt to remove more mussels than necessary to complete scheduled maintenance. Issues such as corrosion, complete removal of mussels and cleaning of the chamber, and effects of debris have not been addressed.

Reference Shafer, D. 1993. "A Preliminary Examination of Odor Problems Caused by Decaying Zebra Mussels," Technical Note ZMR-4-04, Zebra Mussel Research Program, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.